

## *Chromolaena odorata* Linn: A COMPREHENSIVE REVIEW OF MEDICINAL PROPERTIES AND PHARMACOLOGICAL RESEARCH

Sundhararajan R.<sup>1</sup>, Sanjukta Sainath Singh\*<sup>2</sup>, K. Gayathri<sup>3</sup>

<sup>1</sup>Principal, Mohamed Sathak A.J College of Pharmacy, Sholinganallur, Chennai, Tamil Nadu.

<sup>2,3</sup>Associate Professor, Mohamed Sathak A.J College of Pharmacy, Sholinganallur, Chennai, Tamil Nadu.

Article Received: 22 January 2026 | | Article Revised: 12 February 2026 | | Article Accepted: 4 March 2026

**\*Corresponding Author: Sanjukta Sainath Singh**

Associate Professor, Mohamed Sathak A.J College of Pharmacy, Sholinganallur, Chennai, Tamil Nadu.

DOI: <https://doi.org/10.5281/zenodo.19060614>

**How to cite this Article:** Sundhararajan R., Sanjukta Sainath Singh, K. Gayathri (2026) *Chromolaena odorata* Linn: A COMPREHENSIVE REVIEW OF MEDICINAL PROPERTIES AND PHARMACOLOGICAL RESEARCH. World Journal of Pharmaceutical Science and Research, 5(3), 555-558.



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### ABSTRACT

*Chromolaena odorata* Linn. (*Asteraceae*), popularly known as Siam weed, is a medicinally important plant extensively employed in indigenous healthcare systems for the treatment of wounds, infectious conditions, inflammatory disorders, and metabolic ailments. This review critically summarizes available experimental and preclinical evidence on the ethnomedicinal relevance, phytochemical profile, and pharmacological properties of *C. odorata*. Phytochemical studies have identified a wide range of bioactive constituents, including flavonoids, phenolic compounds, alkaloids, tannins, saponins, terpenoids, and volatile oils, which are considered responsible for its therapeutic actions. Pharmacological investigations report diverse biological activities such as antioxidant, antimicrobial, antidiabetic, anti-inflammatory, analgesic, and wound-healing effects, with wound management being the most extensively explored application. Additional activities, including hepatoprotective, anticancer, antipyretic, and insecticidal effects, have also been documented. Toxicological findings suggest dose-dependent safety concerns, highlighting the necessity for rigorous toxicity evaluation. Collectively, the available evidence emphasizes the medicinal potential of *Chromolaena odorata* and supports the need for future research on bioactive compound isolation, mechanistic elucidation, clinical validation, and detailed safety assessment.

**KEYWORDS:** *Chromolaena odorata* Linn., *Asteraceae*, ethnomedical, wound healing, phytochemical, antioxidant, Free Radical Scavenging Activity, Antibacterial and Antimicrobial, Antidiabetic and Metabolic Modulation, Anti-inflammatory, Analgesic, anti-hepatotoxic, anticancer, anti-spasmodic, antipyretic, and insecticidal.

## INTRODUCTION

*Chromolaena odorata* Linn., popularly referred to as Siam weed, is an invasive medicinal shrub belonging to the *Asteraceae* family and is now widely established across tropical and subtropical regions outside its native American origin. Historically classified under *Eupatorium odoratum*, *C. odorata* has been used for centuries in traditional medicines such as Ayurveda, Siddha, and Unani, as well as indigenous folk systems for treating wounds, infections, inflammation, diabetes, and more.<sup>[1,2]</sup>

## ETHNOMEDICINAL AND TRADITIONAL USES

Ethnomedicinal reports indicate that *Chromolaena odorata* leaves have traditionally been applied as topical pastes to wounds, burns, and skin infections, and are used by tribal communities in parts of India and Southeast Asia for rheumatism, poison bites, and skin diseases. The young leaf extracts or pastes are also used to treat diarrhea, malaria, and fevers in various traditional practices, reflecting its broad historical application in folk healing.<sup>[3,4]</sup>

## PHYTOCHEMICAL COMPOSITION

Phytochemical investigations show that *C. odorata* contains a rich profile of bioactive constituents including alkaloids, flavonoids, phenolics, saponins, tannins, terpenoids and essential oils, which are believed to underpin its therapeutic effects. Specific compounds such as eupolin, chromomoric acid, quercetagenin, and quercetin have been identified and linked to wound healing, antioxidant and anti-inflammatory activities. Advanced phytochemical analysis has revealed over 270 compounds across various classes including alkaloids, organic acids, and phenolics, expanding the pharmacological significance of this species.<sup>[4,5,6]</sup>

## ANTIOXIDANT AND FREE RADICAL SCAVENGING ACTIVITY

Multiple studies confirm significant **antioxidant activity** in leaf extracts of *Chromolaena odorata*, assessed using DPPH, nitric oxide and hydroxyl radical scavenging assays. Ethanolic and methanolic leaf extracts demonstrated notable radical inhibition, supporting its potential to mitigate oxidative stress implicated in chronic diseases. A recent study reported strong antioxidant properties correlated with high phenolic and flavonoid content in different plant parts including leaves and stems.<sup>[7,8]</sup>

## ANTIBACTERIAL AND ANTIMICROBIAL EFFECTS

Pharmacological profiling shows that extracts of *C. odorata* have antibacterial activity against a range of Gram-positive and Gram-negative bacteria including *Staphylococcus aureus*, *Escherichia coli* and *Salmonella typhimurium*, although potency varies with extract type and concentration. These effects are supported by phenolic and flavonoid compounds that may disrupt microbial cell walls and biofilms, offering scientific validation for its traditional use in managing infections.<sup>[9,10]</sup>

## ANTIDIABETIC AND METABOLIC MODULATION

Animal studies illustrate the antidiabetic potential of *Chromolaena odorata* extracts. In streptozotocin-induced diabetic rats, ethanolic leaf extracts significantly improved blood glucose levels and reduced diabetic complications including cataract formation, suggesting beneficial effects on carbohydrate metabolism and oxidative stress in diabetes. Recent LC-HRMS analysis also corroborates  $\alpha$ -glucosidase inhibitory activity, an important mechanism for glycemic control.<sup>[9]</sup>

### ANTI-INFLAMMATORY, ANALGESIC AND RELATED EFFECTS

Traditional claims of anti-inflammatory and analgesic properties are supported by pharmacological screenings that report reduced inflammation markers in extract-treated models, though detailed mechanistic studies remain limited. Phytoconstituents such as flavonoids and terpenoids are believed to modulate inflammatory pathways, reinforcing its role in managing pain and inflammation in folk medicine.<sup>[10]</sup>

### WOUND HEALING POTENTIAL

One of the most extensively studied therapeutic areas for *Chromolaena odorata* is wound healing. Clinical and experimental evidence demonstrates that leaf extracts promote wound contraction and faster tissue regeneration, reduce microbial contamination, and improve angiogenesis and collagen synthesis. This activity is attributed to multiple phytochemicals including chromomoric acid and quercetin derivatives. Specialized reviews also underscore its therapeutic relevance in treating chronic wounds and foot ulcers, which are major clinical challenges.<sup>[11,12]</sup>

### OTHER REPORTED BIOLOGICAL ACTIVITIES

Beyond the well-established effects, research points to anti-hepatotoxic, anticancer, anti-spasmodic, antipyretic, and insecticidal activities, although many of these require more thorough clinical and mechanistic investigation. Phytochemical diversity suggests broad pharmacological potential, but specific modes of action and therapeutic indices need further study.<sup>[2]</sup>

### TOXICOLOGY AND SAFETY EVALUATION

While *C. odorata* exhibits promising pharmacological activities, evidence indicates potential toxicity at higher doses and extract types. For instance, brine shrimp lethality and rat toxicity studies highlight dose-dependent toxic effects, warranting careful evaluation of safety profiles before clinical application. Acute toxicity studies in rodents indicate relatively high LD<sub>50</sub> values, but sub-lethal metabolic effects were observed, emphasizing the need for comprehensive toxicological studies.<sup>[13,14]</sup>

### CONCLUSIONS AND FUTURE DIRECTIONS

*Chromolaena odorata* Linn. is a medicinally valuable yet underutilized plant with a broad spectrum of pharmacological activities, including antioxidant, antimicrobial, antidiabetic, anti-inflammatory, and wound healing properties. Numerous phytochemicals have been identified as the basis for its therapeutic effects, and emerging research continues to map its pharmacodynamics and safety. Future investigations focusing on clinical trials, compound isolation, mechanistic pathways, and safety assessments are essential to translate traditional knowledge into evidence-based medical applications.<sup>[4]</sup>

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